



Your voice isn't the only thing transmitted on your mobile phone! Germs are being transmitted too

Mobile phones not just transmit voice but germs too!

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Abstract

Aim: Mobile phones and its usage are inevitable in this tech-savvy medical setup. Their use in the healthcare settings represents a potential source of spreading microorganisms that may contribute to hospital-acquired infections. In recent years much concern has been expressed over the frequent use of these devices by healthcare workers and clinical medical students even in washrooms that can serve as a vector for transmitting pathogens to the patients. **Material and Method:** This cross-sectional study identified microbiological contamination of mobile phones used by clinical medical students at Northern Border University (NBU), Arar, Saudi Arabia. **Results:** Out of 110 mobile phones screened, 99(90%) were contaminated. The most abundant isolates include coagulase-negative Staphylococci 26 (24 %) followed by *Staphylococcus aureus* 20 (18%), *Klebsiella pneumoniae* 6 (5.4%) and *Escherichia coli* 2 (1.8%). Seventy-five (68%) of Gram-positive bacilli were isolated. **Discussion:** Our study indicates that mobile phones can serve as reservoirs of both pathogenic and non-pathogenic microorganisms. To reduce the risk of cross-contamination proper guidelines of hand hygiene; restricted use of mobile devices during clinical working hours and frequent decontamination of these devices and awareness of its usage should be promoted.

Keywords

Hospital Acquired Infections; Mobile Phones; Microbial Contamination; Microbial Resistance; Hand Hygiene; Medical Students; Saudi Arabia.

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Introduction

Hospital-acquired infections (HAIs) are a serious problem in hospitals and are associated with increased morbidity, mortality and financial burden [1]. In developing countries, HAIs affect > 25% of the admitted patients. Approximately 100,000 deaths occur from 1.7 million infections that occur in U.S. hospitals in a year. It is estimated that one-third of these infections could be prevented by keeping up to standard infection control guidelines [2].

The constant handling of mobile phones by Health-care workers (HCWs) including medical students in hospital settings makes it a potential threat for transmission of microorganisms [3]. Studies also demonstrate that incidences of infectious diseases are greater in those people who use contaminated mobile phones [4].

Hand hygiene is effectively promoted for the prevention of hospital acquired infections [5]. But unlike our hands, that are readily disinfected in the hospital setting using alcohol-based hand rubs (ABHRs), poor awareness prevails about the usage of disinfectant to de-contaminate mobile phones [6].

The colonization of these microbes on mobile phones of HCWs may be transmitted to the patients [7]. If these microbes are pathogenic, these are harmful to the health of the patients, and if drug-resistant strains then they are more difficult to treat because of limited drug options available [8]. There are reports of cross-contamination of Methicillin-resistant *Staphylococcus aureus* (MRSA) and Extended-spectrum beta-lactamases (ESBL) occurring by mobile phones used by HCWs [9].

A number of studies have reported 5-21% of mobile phones belonging to healthcare workers to be contaminated, and therefore to be a significant source of the microorganisms responsible for nosocomial infections [10-13].

Lack of documented report in Northern Border University setup leads to this study to investigate the extent of contamination of mobile phones used by the medical students.

Material and Method

Study design

This cross-sectional study was performed from December 2017 to March 2018. The study was approved by the institutional review board.

A total of 110 samples were collected from mobile phones of 55 male and 55 female medical students working in various clinical departments. Written informed consent was obtained before sample collection. All participants were asked to complete a predesigned questionnaire for data collection of which the questions were regarding their awareness about the transmission of pathogens through contaminated mobile phones, their awareness about disinfection of mobile phones, and its frequency, the disinfectant used; the use of the mobile phone during clinical working hours, and in washrooms.

Sample collection and processing

Samples were obtained from the mobile phones of all volunteer medical students using sterile swabs.

The sterile swab was drenched in the test tube containing nutrient broth medium, after which they were rotated over the front screen and the back of the mobile phones and put inside

the test tube containing nutrient broth medium. The samples were transported immediately to the laboratory and they were incubated at 37°C for 24 hours.

Using sterile swabs, the contents of these test tubes were inoculated to solid medium plates (Blood agar and MacConkey agar) and incubated at 37°C for 24 hours [14].

Identification of Isolates and antibiotic susceptibility

Isolated colonies were identified using standard microbiological methods [15]. Isolated bacterial colonies were further subjected for antibiotic susceptibility test to identify the resistant pattern using Kirby Bauer disk diffusion method. Cefoxitin (30 µg) disk was used to identify Methicillin-resistant *Staphylococcus aureus* (MRSA) and Methicillin-resistant coagulase-negative staphylococcus (MRCoNS). While Cefotaxime (30 µg) and Cefotaxime plus Clavulanic acid (30µg/10µg) and Ceftazidime (30 µg) and Ceftazidime plus Clavulanic acid (30µg/10µg) for identifying Extended-spectrum beta-lactamases (ESBL) producing gram-negative bacilli.

The inhibition zone diameters were measured and interpreted as recommended by the Clinical and Laboratory Standards Institute (CLSI).

Results

Out of 110 samples taken from mobile phones, 99 (90%) were tested positive for contamination. Among the 99 mobile phones tested positive, 49 were contaminated with a single organism, 42 with dual, and 8 were with triple organisms.

The questionnaire from the students revealed that 49 (44.5% 49/110) students presume that their mobiles are clean. Thirty percent agree that their mobile phones carry pathogens and can spread infections. Twenty-seven percent of students used to clean their phones using 70% alcohol but none of the students were doing it on regular interval. All of the participants were using their mobile phones during clinical working hours.

Twenty-five (45% 25/55) male students and 11(20% 11/55) female students used their mobile phones in the washroom, whereas, 30 (27%) male students and 44 (40%) female student participants did not use their mobile phones in the washroom.

Fifty-four mobile phones from male and 45 mobile phones from female medical students had contaminants.

The number and type of organisms isolated on mobile phones among male and female students are shown in Table 1.

Among Gram-positive cocci (GPC), CoNS were (26) followed by *Staphylococcus aureus* (20), *Micrococcus* spp. (27) and *Enterococcus faecalis* (6). Eight GNB were isolated which includes *Klebsiella pneumoniae* (6) and *Escherichia coli* (2). Among the Gram-positive bacilli, 42 aerobic spore bearers (ASBs) and 33 diphtheroids were isolated. Distribution of type of organism isolated from mobile phones (including decontaminated mobiles) is shown in Table 2 and distribution of resistant isolates from mobile phones is shown in Table 3.

Thirty students in our study decontaminated their mobile phones using 70% alcohol. Among these decontaminated mobile phones, only 4 were found to be without growth; while 26 had growth with single and multiple pathogens. Table 4 shows the number of organisms isolated from decontaminated mobile phones.

Table 1. Number and type of organisms isolated on mobile phones among male and female students.

Gender	Type of organism isolated from mobile phones		
	Gram-positive cocci	Gram-negative bacilli	Gram-positive bacilli
Male students	47	2	36
Female students	33	6	39

Table 2. Distribution of type of organisms isolated from mobile phones (including decontaminated mobiles phones).

Type of organism	Number (n= 162)*	Percentage
<i>Staphylococcus aureus</i>	20	18.1%
CoNS	26	23.6%
<i>Micrococcus</i> spp.	27	24.5%
<i>Enterococcus faecalis</i>	6	5.4%
<i>Klebsiella pneumoniae</i>	6	5.4%
<i>Escherichia coli</i>	2	1.8%
Aerobic spore bearers (ASBs)	42	38.2%
Diphtheroids	33	30%

Table 3. Distribution of resistant isolates from mobile phones.

Methicillin-resistant Gram-positive cocci				ESBL producing Gram-negative bacilli	
MRSA	MSSA	MRCoNS	MSCoNs	<i>E. coli</i>	<i>K. pneumoniae</i>
2	18	2	23	1	2

Table 4. Number and type of organism isolated from decontaminated mobile phones.

Name of the Organisms	Number of mobile phones
MRCoNS	4
Diphtheroids	4
Diphtheroids + <i>Staphylococcus aureus</i>	3
MSCoNS + <i>Micrococcus</i> spp	8
<i>E.coli</i> + MSCoNS	5
<i>Enterococcus faecalis</i> + MSCoNS	2

Discussion

Mobile phones use has become unavoidable in our daily routine life. They are widely used for communication in all fields of work including health care staff in hospital settings and medical students in clinical departments. Where there are benefits connected to the use of mobile phones, the risk of transmission of bacterial pathogens from these mobile phones used by the medical students in hospitals is also a concern of importance. And if the transferred organisms turn out to be drug-resistant strain then it is more difficult to treat because of the limited drug options. [8]

The mobile phones of HCWs are more contaminated due to the reason that they are dealing with patients in hospital setup [16]. As medical students are present in hospitals and come in contact with different patients in different departments they can be a potential source of transmitting infectious pathogens between patient if due care is not taken.

In our study, 99 (90%) of mobile phones used by medical stu-

dents were contaminated which is less when compared with the previous study showed 96.2% contamination among the mobile phones of medical students [17]. Out of 110 mobile phones, 7 resistant pathogens were found to be present. Two MRSA & MRCoNS each and three ESBLs (2 *K. pneumoniae* and 1 *E. coli*). Based on the questionnaire, 55.5% of students are aware that their mobiles were not clean and 30% carry pathogens; despite of knowing it they were reluctant to disinfect it. This indicates that they have less awareness about the usage of unclean mobile phones during clinical working hours which could serve as a vehicle for transmitting pathogens and non-pathogens among patients. Thirty-six (33%) medical students used their mobile phones in washrooms, which is less than in the previous study (59%) conducted in medical students [17]. In our study, 80 (73%) of mobile phones are never been decontaminated, whereas (67.6%) was reported in another study done among medical students [17].

The use of 70% alcohol to clean the mobile phone is one of recommended decontamination method that showed a significant decrease in the number of microbial contaminants [18-20]. The pathogens can survive on the surface of the mobile phones if they are not disinfected properly. In our study, data on the mobile phone disinfection collected from the medical students show that the irregular disinfection of mobile phones with does not guarantee the absence of pathogens. In spite of disinfection, out of 30 mobile phones 26 had growth with single or multiple microorganisms. There were no differences in the type of organism isolated from the contaminated and decontaminated mobile phones. Most of the organisms isolated from the mobile phones must have transferred from their hands [21]. It was reported that 30% of the bacteria on the phones are from the hands of the users and it was well supported by other researchers [21,22].

Thus, it is suggested that the limited use of mobile phone should be advised for medical students in high-risk areas and in wards during their clinical working hours. More awareness should be given about not just hand hygiene but also on decontaminating mobile phones with 70% alcohol or alcohol-based sanitizer at regular intervals or even daily basis [6, 17, 23].

In our study, we found that the microorganisms either pathogenic or non-pathogenic are present on the mobile phones of medical students and have high potential to get transferred. The limited use and awareness about the hand hygiene and regular or daily decontamination of mobile phones with proper disinfectant could limit the possibility of transmission of infections in health-care settings.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later

amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

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References

1. Revelas A. Healthcare – associated infections: a public health problem. *Niger Med J*. 2012; 53: 59–64.
2. Tekerekoglu MS, Duman Y, Serindağ A, Cuğlan SS, Kaysadu H, Tunc E, et al. Do mobile phones of patients, companions and visitors carry multidrug-resistant hospital pathogens? *AJIC: American Journal of Infection Control*. 2011; 39: 379–81.
3. Kokate SB, More SR, Gujar V, Mundhe S, Zahiruddin QS. Microbiological flora of mobile phones of resident doctors. *J Biomed Sci Eng*. 2012; 5: 696–8.
4. Khan S, Shaikh AA. Mobile phones: reservoir of infectious diseases in university premises. *NED University Journal of Research* 2012; 9: 35–43.
5. Edem EN, Onwuezobe IA, Ochang EA, Etok CA, James IS. Antibigram of bacterial isolates from the anterior nares and hands of health care workers in University of Uyo Teaching Hospital [UUTH] Uyo, Akwalbom State, Nigeria. *Journal of Bacteriol Parasitol* 2013; 4: 1–5.
6. Marcham C. Coats, ties, stethoscopes, cell phones, and id badges: potential sources of healthcare-associated infections? *Environmental health and safety*. 2009; 16: 1–4.
7. Kilic IH, Ozaslan M, Karagoz ID, Zer Y, Davutoglu V. The microbial colonisation of mobile phone used by healthcare staffs. *Pak J Biol Sci*. 2009; 12: 882–4.
8. Angadi KM, Misra R, Gupta U, Jadhav S, Sardar M. Study of the role of mobile phones in the transmission of Hospital acquired infections. *Med J DY Patil Univ*. 2014; 7: 435–8.
9. Sadat-Ali M, Al-Omran AK, Azam Q, Bukari H, Al-Zahrani AJ, Al-Turki RA, et al. Bacterial flora on cell phones of health care providers in a teaching institution. *Am J Infect Control*. 2010; 38: 404–5.
10. Otter JA, Yezli S, French GL. The role played by contaminated surfaces in the transmission of nosocomial pathogens. *Infect Control Hosp Epidemiol* 2011; 32: 687–99.
11. Dancer SJ. The role of environmental cleaning in the control of hospital acquired infection. *J Hosp Infect*. 2009; 73: 378–85.
12. Boyce JM. Environmental contamination makes an important contribution to hospital infection. *J Hosp Infect*. 2007; 65: 50–4.
13. Brady RR, McDermott C, Fraise AP, Verran J, Gibb AP. Healthcare workers' mobile phones are rarely contaminated by MRSA in the non-clinical environment. *J Hosp Infect*. 2009; 72: 373–4.
14. Darvishi M, Nazer MR. Studying the level of microbial infection of mobile phones among nurses working in the intensive care units of hospitals. *IIOABJ*. 2017; 8: 8–12.
15. Forbes BA, Sahm DF, Weissfeld AS. Bailey and Scott's diagnostic microbiology. 12th ed. St Louis: Mosby; 2007; 216–51.
16. Girma MM, Ketema A, Gemed A. Bacterial contamination of mobile phones of healthcare workers at Jimma University Specialized Hospital, Jimma, South West Ethiopia. *Int J Infect Control*. 2014; 11: 1–8.
17. Zakai S, Mashat A, Abumohssin A, Samarkandi A, Almaghrabi B, Barradah H, et al. Bacterial contamination of cell phones of medical students at King Abdulaziz University, Jeddah, Saudi Arabia. *J Microsc Ultrastruct*. 2016; 4: 143–6.
18. Goldblatt JG, Krief I, Klonsky T, Haller D, Milloul V, Sixsmith D.M, et al. Use of cellular telephones and transmission of pathogens by medical staff in New York and Israel. *Infect Control Hosp Epidemiol*. 2007; 28: 500–3.
19. Jayalakshmi J, Appalaraju B, Usha S. Cellphones as reservoirs of nosocomial pathogens. *J Assoc Physicians India*. 2008; 56: 388–9.
20. Beer D, Vandermeer B, Brosnikoff C, Shokoples S, Rennie R, Forgie S. Bacterial contamination of health care workers' pagers and the efficacy of various disinfecting agents. *Pediatr Infect Dis J*. 2006; 25: 1074–5.
21. Selim HS, Abaza AF. Microbial contamination of mobile phones in a health care setting in Alexandria, Egypt. *GMS Hyg Infect Control*. 2015; 10: 1–9.
22. Meadow JF, Altrichter AE, Green JL. Mobile phones carry the personal microbiome of their owners. *Peer J*. 2014; 2: DOI:10.7717/peerj.447
23. Ghatole KP. Mobile phones– do we need decontamination? *J Evid Based Med Healthc*. 2018; 5(5), 425–8.

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